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COMPARATIVE DATA ON RESPIRATION AND CIRCULATION AMONG NATIVE AND FOREIGN BORN MALES IN NEW YORK CITY.

BY

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COMPARATIVE DATA ON RESPIRATION AND CIRCULATION AMONG NATIVE AND FOREIGN BORN MALES IN NEW YORK CITY.

By Clark Wissler.

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Foreword.

The data upon which this study is based were gathered incidentally in the course of medical examinations conducted by Local Draft Board No. 129, New York City, of which the writer was Examiner-in-chief.

After recovering from the rush of the first draft, in which we were overwhelmed by the examination of a host of normal persons, it occurred to the writer that there offered an opportunity to collect data from normal individuals and correlate the findings. As the registrants passed through our hands it seemed that possibly some so-called symptoms might actually be normal variations and further that such racial characters as may prevail normally might have been smoothed out under the average conditions of American life, and lastly, that some endocrinological stigmata might be verified as such, with their correlations, or discarded. This was especially appropriate, as we were at that time entirely dependent on foreign authors for anthropological studies and scientific photographs of white men. The fact that we could examine only a relatively small number of registrants we sought to offset by the painstaking care and thoroughness of the examinations. Our district represented a typical segment of our urban population, preponderantly of the middle class, but it included both very poor and very rich. Here, coming directly to the American Museum of Natural History, where the Board met, was opportunity for studying *Homo Sapiens* in his environment. What could be more appropriate than coöperation in the study with the Department of Anthropology of that great foundation? So, when the writer suggested this plan to gather supplementary data, the staff of the Museum, from President Henry Fairfield Osborn down, heartily joined in placing at our disposal adequate quarters so that the extensive examinations required could be expeditiously performed by a large number of examiners working simultaneously, and also in detailing trained members of its scientific staff to assist in the examination. Acknowledgment for cordial support should be made to my fellow members of Local Board No. 129, Mr. Julius Henry Cohen and Mr. Benedict Erstein.

Finally, the writer wishes to acknowledge the coöperation of the following physicians and specialists, whose skill and intimate knowledge of their respective fields, guarantees the integrity of the data.

Dentists: Dr. David Kreisler, Dr. Joseph Levy.

Laryngologists and Otologists: Dr. William L. Gatewood, Dr. Henry L. Lynah.

Neurologists: Dr. S. Philip Goodhart.

Occulists: Dr. Martin Cohen, Dr. Francis Gulliver.

Orthodontists: Dr. B. W. Weinberger.

Physicians: Dr. Zama Felbstein, Dr. Meyer H. Freund, Dr. Carl Goldmark, Dr. J. P. Gould, Dr. Henry Mosler, Dr. Jesse Schwartz, Dr. Lewis M. Silver, Dr. A. R. Stern, Dr. Salo N. Weber, Dr. Benno Wronker.

Jesse G. M. Bullowa, M.D.

October, 1923.

CONTENTS.

	Page.
Foreword	261
Introduction	265
Race, Nationality, Parentage, and Age	267
Distinctions between the Foreign and the Native-Born	268
Grouping by Occupation	268
Respiratory and Circulatory Data	272
Methods of Compilation	272
Respiration Rates	273
Vital Capacity	274
Chest Measurements	276
Pulse Rate	283
Blood Pressure	290
Temperature	294
Summary	297
Correlations	298
Pulse Rate	298
Blood Pressure	300
Vital Capacity and Mobility	300
Temperature	301
Miscellaneous Medical Data	302
Summary	307

LIST OF ILLUSTRATIONS.

Text Figures

		Page.
1.	Pulse Graphs, Table 14	288
2.	Temperature Graph on Basis of a Thousand Cases	295

Introduction.

During the late war the Museum building and its equipment were placed at the disposal of the Local Draft Board. This gave opportunity for the author of this paper and the members of his staff to assist in the physical and medical examinations. In 1918 Doctor Jesse G. M. Bullowa, the supervising examiner, as stated in the Foreword, suggested that the examining board individually and systematically note supplementary data. Accordingly, a schedule was drawn supplementing the regular examination. This was carried through, as circumstances permitted, until the examinations were discontinued at the termination of the war. Later on, some of the data secured were tabulated, forming the basis of this publication.

Extensive reports on draft data in general have been published by Major Albert G. Love and Doctor Charles B. Davenport.[1] Unfortunately, no account of ancestry was taken in the regular draft, for which amends were made by a geographical classification according to residence and then interpreting the geographical groups so segregated according to the dominant ancestry as revealed by the census. At best, this is a crude method. However, at the demobilization of our army special examinations were given 100,000 men at which time the ancestry and place of birth were recorded.[2] In the compilation of these statistics, however, no distinctions were made between the foreign and the native born, we have therefore thought it advisable to consider from that standpoint the small number of observations reported upon here. As a sample of our population they will, at least, suggest what could be done by following out this method extensively.

The supplementary examination conducted by us comprised observations under the following heads:—

1. Ancestry and nationality.
2. Examinations of the teeth and measurements on the jaws.
3. Measurements and observations on the head and body.
4. Circulatory and respiratory functions.
5. Finger and sole imprints.

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[1] "Defects found in Drafted Men" (*Statistical Information compiled from the Draft Records showing the Physical Condition of Men registered and examined in pursuance of the requirements of the Selective Service Act*, Printed for the Use of the Senate Committee on Military Affairs. Washington, 1919); "Physical Examination of The First Million Draft Recruits: Methods and Results" (*War Department, Office of the Surgeon General*, Bulletin 11, Washington, 1919); "Defects found in Drafted Men" (*The Scientific Monthly*, January–February, 1920); "Defects found in Drafted Men" (*Statistical Information compiled from Draft Records showing the Physical Condition of the Men Registered and Examined in Pursuance of the Requirements of the Selective-Service Act, War Department*, Washington, 1920).

[2] Davenport, Charles B. and Love, Albert G., "The Medical Department of the United States Army in the World War," (*Vol. XV, Statistics, Part 1, Army Anthropology, Based on Observations made on Draft Recruits, 1917–1918, and on Veterans at Demobilization*, 1919, Washington, 1921).

Since the subjects vary in their ancestral origin we may expect them to show both hereditary and cultural differences. No one doubts that a man inherits physical and mental characters from his parents and that there are real differences between national groups like the Irish, French, Italians, etc. Yet, we have next to no available data on the subject, at least no data that can be called scientific. Hence, as a fundamental part of this examination we called for a full account of the subject's ancestry to the third generation. In case he represented more than the third native-born generation, data were secured as to the number of generations born in the United States. Additional data concerning the social and cultural position of the subject were secured.

Race, Nationality, Parentage, and Age.

The tables for parentage (1–2) give us a detailed analysis of national and racial elements in the group. From the records of the 456 men examined, we see that 104 were foreign born, or approximately one-fourth. These citizens of foreign birth represent twenty-seven countries, to which may be added Jews of five nationalities. The Irish are far in the lead, comprising about one-fifth of the total.

The distribution for the parents of the foreign born indicates that they are of pure stock. In other words, when a foreign born citizen is met, it is reasonably certain that his parents and grandparents were born under the same nationality as he.

When we turn to the 352 native born we find that while 178 of them had native born fathers, 174 were sons of foreign-born fathers. The number of native born mothers is 205. When we regard the grandparents, the number of native born falls to 96. This we may anticipate that but a small fraction of the 172 native born can qualify as old American stock. Of the foreign born fathers the Irish are again in the lead, but if the distinction as to Jews be disregarded they do not exceed the Germans. The total of foreign born Jewish fathers is 65.

While the original intent in gathering the data was to correlate the various observations with each other and with racial characters, it is now seen that the cases are too few for an exhaustive analysis. Our foreign born subjects are far from a homogeneous group in terms of racial characters and the individuals comprising the same have lived under many different environments. This must be borne in mind when we come to interpret the results presented here.

Our groups can be further analyzed as to age (3). According to the requirements of the draft all the subjects fall into two main age groups: 18 to 23, and 32 to 37. It will be necessary to take these differences into account as the discussion proceeds.

Distinctions between the Foreign and the Native Born. The investigations of Boas[1] followed by Guthe[2] and Hrdlicka[3] seem to indicate changes in bodily proportions of children born of foreign parents, suggesting that the new environmental complex modifies growth. Anyway it seems advisable to tabulate our data with respect to ancestry as indicated by

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[1]Boas, Franz, "Changes in Bodily Form of Descendants of Immigrants" (*Reports of the U. S. Immigration Commission*, Washington, 1911, *Columbia University Press, 1912*).

[2]Guthe, C. E., "Notes on the Cephalic Index of Russian Jews in Boston" (*American Journal of Physical Anthropology*, Vol. 1, 213–223, 1918).

[3]Hrdlicka, A., "The Old White Americans" (*Proceedings, Nineteenth International Congress of Americanists*, 582–601, Washington, 1917.)

the place of birth. We have therefore divided our subjects into two main groups, foreign born and native born. The latter we have again subdivided according to parentage into foreign, native, and mixed groups. Thus, all whose fathers and mothers were born in the United States were placed in one group; those who had one parent of foreign birth in another, etc. A comparison of the data for each throughout the series of examinations will show what differences, if any, we may expect between the foreign and the native born as represented here.

One pertinent objection to this procedure is that we are disregarding national lines, which is true; the small number of cases, as we have said, precludes any other method of grouping. Yet, it will be noted that, in the main, the ancestry of the native born in this series is the same as that of the foreign born. Care was also taken to exclude the very few individuals of non-European origin. Thus, the treatment we have given the data should reveal differences between the native and foreign born of European stock, if such differences exist. It is because the respective national groups are represented about equally among our nativity groups that the data for each can be considered comparable.

Grouping by Occupation.

Each subject gave his occupation, the answers being specific. These we have grouped under seven arbitrary heads, as shown in the table, where the kind of work seemed comparable. We have plotted these from the United States parentage and foreign born groups only, since the differences between the groups are not great.

Grouping by Occupation.

	U. S. Parents		Foreign Born	
	n	%	*n*	%
Chauffeur	13	9	6	7
Clerical	47	33	11	12
Laborer	2	1	14	15
Mechanical	21	15	21	24
Professional	24	17	16	18
Salesman	28	20	18	20
Student	8	5	4	4
Totals	143	100	90	100

TABLE 1.

BIRTHPLACES OF THE FOREIGN BORN.

	Birthplace of Individuals Examined	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother
Armenia	1	1	1				
Austria	1	1	1	1	1	1	1
Austrian-Jew	5	5	3	2	2	1	1
Bohemia						1	
Bohemian-Jew						1	1
Brazil	2	2	1	1	1	1	1
British West Indies	4	4	4	3	3	2	3
Canada	6	3	4	2	1	1	1
China		1	1	1	1	1	1
Denmark	1	1	1				
England	9	9	8	9	7	4	5
France	3	3	3	4	3	3	3
Germany	6	8	8	6	6	7	6
German-Jew	7	5	6	4	5	5	5
Greece	1	1	1	1	1	1	1
Holland	1	1	2	1	1	1	1
Hungary	1	1	1	1	1	1	1
Hungarian-Jew	2	3	4	2	2	2	2
India	1						
Ireland	22	23	21	20	21	22	21
Italy	7	6	7	4	4	4	4
Luxemburg	1	1	1	1	1	1	1
Norway	1	1	1	1	1	1	1
Poland	1	1	1	1	1	1	1
Porto Rico	3	3	3	1	1	1	1
Roumanian-Jew	1	1	1	1	1	1	1
Russia	3	2	2	2	2	2	2
Russian-Jew	7	6	6	4	4	4	3
Scotland	4	2	2	2	3	2	2
South Africa	1		1				
Spain				1	1	1	1
Sweden	1	1	1				
West Indies	1	1	1	1	1	1	1
Totals	104	97	97	77	76	74	72

TABLE 2.

BIRTHPLACES FOR PARENTS OF THE AMERICAN BORN.

	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother
Austria	1	1	1			
Austrian-Jew	10	3	5	6	2	3
Belgian-Jew					1	
Bohemian-Jew	3	1	2	2	2	2
Canada	3	1	1		1	1
Denmark	1	1	1	1	1	2
England	9	7	13	12	12	9
English-Jew						1
France	5	4	5	6	5	4
French-Jew	4		2	3	3	2
Germany	23	12	21	22	23	21
German-Jew	27	16	29	29	28	28
Holland (Jew)			2	2	1	1
Hungary	1	1	1	1	1	1
Hungarian-Jew	1	2	1	1	1	1
Ireland	52	45	51	52	52	49
Italy	2	2	2	2	2	2
Norway	1	1	1	1	1	1
Polish-Jew	2	1				
Roumania	1	1	1	1	1	1
Russian-Jew	17	13	14	14	12	12
Scotland	5	4	5	4	4	2
Sweden	1					
Switzerland	2		4	2	2	1
United States	178	205	96	86	86	93
United States (Jew)	1	29			1	4
Venezuela	1					
Totals	351	350	258	247	242	241

TABLE 3.
DISTRIBUTION BY AGE.

Yrs.	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
18	8	5	4	2	19
19	14	9	20	8	51
20	23	4	18	8	53
21	11	2	7	3	23
22		1	5	3	9
23	3	2	3	3	11
24	4	3	5	2	14
25	5	1	1	1	8
26	1	1	3	3	8
27	3		2	1	6
28	5	1	1	1	8
29	1	1	2	2	6
30	7	1	2	1	11
31	7	1	2	7	17
32	9	4	9	8	30
33	14	9	4	15	42
34	11	8	9	11	38
35	18	4	12	12	46
36	9	6	5	12	32
37	5	1	1	1	8
38			1	1	2
39		1	1		2
40	2				2
41	1				1
42	1		2		3
43		1			1
44	1				1
45	1		1	1	3
Totals	164	66	120	106	456

Respiratory and Circulatory Data.

Accompanying the required examination were a number of supplementary observations on health, function, etc., a few of which readily lend themselves to statistical treatment. Accordingly, we have tabulated these data under the same heads as in the preceding. In certain studies at the Nutrition Laboratory of the Carnegie Institution, pulse rate, blood pressure, and respiration rates have been studied with precision and continuity for a number of experimental squads of ten or more adult white males. Incidentally, the reports of these experiments furnish check data for our results.[1]

Table 4.

Respiration Rates.

Rate	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
14	1				1
16	1	1	2	1	5
18	19	10	20	6	55
20	55	21	34	27	137
22	37	14	24	29	104
24	22	4	16	20	62
26	6	2	1	1	10
28		1	2		3
n	141	53	99	84	377
A	21.06	20.755	19.869	21.523	
σ	2.220	2.307	2.364	1.942	
V	.105	.111	.118	.09	
Em	.187	.317	.124	.212	

Methods of Compilation. In the treatment of these data we have used the customary biometric methods as applied to variable data. These are sufficiently described elsewhere, but are seldom applied to medical data.

[1]Benedict, Francis G., Miles, Walter R., Roth, Paul, and Smith, H. Monmouth, "Human Vitality and Efficiency under Prolonged Restricted Diet" (*Publication 280, Carnegie Institution of Washington*, Washington, 1919).

Benedict, Francis G. and Cathcart, Edward P., "Muscular Work, a Metabolic Study with Special Reference to the Efficiency of the Human Body as a Machine" (*Publication 187, Carnegie Institution of Washington*, Washington, 1913).

Benedict, Francis G. and Slack, Edgar P., "A Comparative Study of Temperature Fluctuations in Different Parts of the Human Body" (*Publication 155, Carnegie Institution of Washington*, Washington, 1911).

Also, the point of view in this research is different from that in medical research where the individuals to be studied are selected according to health conditions, attention usually being given to the ill and the pathological. Again, in medical research the attention is given to cases. Our point of view is that of an anthropologist,—the study of groups taken as samples from given populations. Individuals, as such, are not considered, but a picture of the biological, or racial, group is sought with respect to isolated criteria. So we shall look upon the ancestral groups examined for military service, as samples of the populations from which they are drawn. Our chief concern will be to compare the aggregate status of the groups noted with respect to the medical observations previously enumerated.

Respiration Rates. The tabulation of the observed rates of respiration show but accidental differences between the ancestral groups, so we may consider them equivalent throughout.

The form of distribution has been commented upon by Julia Bell[1] as approximating an unsymmetrical type. Yet, the distributions in her data closely approximate those in our table, so we may suspect that this form of curve is the approximate picture of respiration rates in adult males of European ancestry.

The nutrition experiments just noted show that a squad of adult males varied in individual respiration rates as follows: lying down 11 to 15, standing 14 to 25, and after walking six minutes, 17 to 30.[2] Our data were taken standing and so are comparable to the 14 to 25 range, since we have 14 to 28. Careful observations on the breathing rate of 255 soldiers in Budapest are reported by Bell.[3] Repeated counts were made upon these subjects before rising in the morning. The averages were 15.84 ± 2.35 and the range from 9 to 25. All of our subjects were examined in the evening, 8 to 11 p.m.

Observations have been recorded by Hrdlicka[4] for American Indians as varying from 12 to 22 in males, from which he concludes that they are approximately equal to white males. Ferris[5] gives data for the Quichua Indians: n, 78, av. 17.2 ± 1.8. Yet one point should be noted, viz., the

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[1]Bell, Julia, "On Pulse and Breathing Rates and their Relation to Stature" (*Biometrika*, vol. 8, pp. 232–235, Cambridge, 1912).

[2]Benedict, Francis G., Miles, Walter R., Roth, Paul, and Smith, H. Monmouth, "Human Vitality and Efficiency under Prolonged Restricted Diet" (*Publication 280, Carnegie Institution of Washington*, Washington, 1919), 468–478.

[3]Bell, *op. cit.* 232–236.

[4]Hrdlicka, Ales, "Physiological and Medical Observations among the Indians of Southwestern United States and Northern Mexico" (*Bulletin 34, Bureau of American Ethnology*, Washington, 1908), 142.

[5]Ferris, H. B., "Anthropological Studies on the Quichua and Machiganga Indians" (*Transactions, Connecticut Academy of Arts and Sciences*, vol. 25, pp. 1–92, New Haven, 1921), 52.

rate fluctuates with bodily position, exercise, etc. Even mental excitement will modify it. Hence, caution must be observed in comparing data taken at different places and under uncertain conditions.

Vital Capacity. The readings were taken with a wet spirometer. Instructions were given the subject and a preliminary trial allowed before the actual test. An examination of the tables reveals large differences between the respective groups, almost too large to be considered accidental by the usual method of valuation.

The form of distribution seems to be symmetrical, but a certain amount of rounding off is apparent in reading the scale. These irregularities can be readily smoothed out by interpolation, if desired. This, however, will not materially modify the averages.

The highest readings, however, are those for the small group of mixed parentage. Yet the readings for those of United States parents exceed that for the foreign born by 155+. The order of rank is, mixed parentage, United States parents, foreign parents, foreign born.

However, we should be reminded that the variability in repeated tests of the same subject is believed to be large, and in consequence, introduces another undetermined factor into the equation expressing the range of the average for the group. Further, some observers consider that in spirometer readings a great deal depends upon the spirit with which the subjects enter into the test. For example, the more Americanized men may have come to the test with a greater sporting spirit than those of more immediate foreign antecedents. That this is a possible factor will appear in another part of this discussion.

Previous investigations with the spirometer indicate that readings may be modified by sex, dress, age, size, mode of life, health, etc.[1] Of these, sex and dress were eliminated as a disturbing factor. As to the mode of life and health no great differences are to be expected. There is, however, a slight difference in average age, the foreign born being older. It has been noted, however, that the readings vary with height and weight. According to Wintrich, as quoted by Whipple, "the average vital capacity for each centimeter of height is, from 8 to 10 years, 10 cc., from 16 to 18 years, 20.65 cc., and at 50 years, 21 cc. Schuster found the general correlation between vital capacity and height to be +.57, and that between the same capacity and weight to be +.59. It follows that in estimating the status of a given individual's vital capacity allowance must be made for his size of body as well as for his age."[2]

[1]For a critical discussion of this test and a bibliography, see, Whipple, G. M., *Manual of Mental and Physical Tests* (Baltimore, 1914).
[2]Whipple, *ibid.*, 95–98.

TABLE 5.

VITAL CAPACITY.

Cc.	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
800			1	1	2
850					
900			1		1
950					
1000	1		2	4	7
1050	2		1		3
1100	1	1	1		3
1150					
1200	4	1	2	8	15
1250		1		2	3
1300	4	3	4	10	21
1350	1	1	1	2	5
1400	6	3	5	2	16
1450	1	1	3	2	7
1500	15	1	9	4	29
1550	3	2	1	3	9
1600	11		9	11	31
1650	5	1	2	1	9
1700	18	9	16	6	49
1750	5	2	3	5	15
1800	12	2	11	5	30
1850	3		2	1	6
1900	10	5	3	7	25
1950	3			1	4
2000	7	5	3	3	18
2050	2		1		3
2100	2	2	7	2	13
2150	1		4	1	6
2200	5	2		1	8
2250	2				2
2300	2	3	2		7
2350					
2400	1	1		1	3
2450	1	1			2
2500	2	1	1		4
2550					
2600		1			1
n	130	49	95	83	357
A	1724.23	1797.75	1667.36	1568.67	
σ	292.23	363.73	314.01	315.75	
V	0.17	0.21	0.19	0.20	
Em	25.62	51.96	32.21	34.65	

The statures of all the native born were approximately equal, but exceeded the foreign born by 2.5 cm. According to the above then, a correction of about 51.6 should be made, reducing the difference between those born of United States parents and the foreign born to 104+, and the corresponding difference from the mixed parentage group to 177+. These reduced differences are still large, though much less certain.

Chest Measurements. It is conceivable that if a real difference in lung capacity existed, similar differences should be observed in the dimensions of the chest and its expansion. So we turn to the data for the anterior-posterior and the transverse diameters and for inspiration and expiration.

For the diameters the values are:—

	n	*A*	σ	*V*	*Em*
United States parents	166	19.916	2.243	.1126	.174
Mixed parents	63	20.206	1.970	.097	.248
Foreign parents	109	20.358	2.612	.128	.250
Foreign born	104	20 509	2.090	.102	.205

It will be noted that these differences are too small to be certain and yet they are consistent in that the greater diameter goes with the degree of foreign birth.

The transverse diameter is as follows:—

	n	*A*	σ	*V*	*Em*
United States parents	156	27.865	2.088	.0749	.167
Mixed parents	66	28.045	2.345	.0836	.289
Foreign born	105	28.009	2.100	.0749	.205
Foreign parents	111	27.288	2.462	.0902	.234

These differences are certainly too small to be considered other than accidental. Yet, the foreign born are again near the maximum. It is therefore apparent that there can be no direct relation between the spirometer readings as noted and the diameters of the chest. Of course, this does not mean that within the respective groups there are no positive correlations for the two measurements.

The army measurements at demobilization also show small differences for the above diameters, but still the actual rank when grouped by nationality[1] was:—

[1]Davenport, C. B., and Love, A. G., "The Medical Department of the United States Army in the World War," (*Volume XV, Statistics. Part 1, Army Anthropology*, Washington, 1921), 210.

	Transverse Diameter
1. Polish	29.22
2. German	29.12
3. Scotch	29.01
4. English	28.87
5. Irish	28.77
6. Italian	28.76

The usual measurements for girth of chest at expiration and inspiration and the consequent mobility are presented in the table in inches. It will be noted that the differences in mobility, as they stand, are within the accidental range, except the United States parentage group and the foreign born, which approximates certainty. Also the rank is consistent as United States parentage, mixed parentage, foreign parentage, and the foreign born, whereas in the actual girth of chest the order is reversed.

The question may be raised as to the influence of occupation upon mobility, because it is probable that habits of posture and work will modify the record. Reference to our occupational table indicates that whatever advantage there is in this respect should lie with the foreign born, who are slightly more given to physical exertion. Yet, the foreign born show the lower reading. As to age, if we consider those over twenty-seven years only, the case stands:—

	n	A	σ
United States parents	100	3.138	0.90
Foreign born	78	2.697	0.75

Here again the foreign born are inferior to those of native parentage.

So it appears that we have a consistent result in all respiratory data in that, though the United States native group had a smaller chest, they blew more air into the spirometer and expanded their chests more.

TABLE 6.

ANTERIOR-POSTERIOR DIAMETER.

Cm.	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
14	2		2		4
15	3		1		4
16	7	3	4	1	15
17	17	2	5	7	31
18	14	7	14	7	42
19	21	9	12	16	58
20	30	15	21	23	89
21	29	14	19	22	84
22	25	3	13	14	55
23	11	6	5	7	29
24	6	4	6	4	20
25	1		2	1	4
26			3		3
27			1		1
28			1	2	3
n	166	63	109	104	442
A	19.916	20.206	20.358	20.509	
σ	2.243	1.970	2.612	2.090	
V	.1126	.097	.128	.102	
Em	.174	.248	.250	.205	

TABLE 7.
CHEST AT EXPIRATION.

Inches	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
28	5		1	2	8
29	14	2	6	4	26
30	13	7	14	10	44
31	28	9	19	10	66
32	31	7	26	25	89
33	24	16	21	23	84
34	23	9	11	14	57
35	11	3	6	10	30
36	4	3	4	5	16
37	4	2	2	5	13
38	2	3	1	3	9
39		1	2		3
40			1		1
41			2		2
42					
43		1		1	2
44		2			2
45					
46		1			1
n	159	66	116	112	453
A	32.157	33.666	32.466	32.938	
σ	2.191	3.504	2.496	2.358	
V	.0681	.104	.077	.072	
Em	.174	.431	.212	.223	

TABLE 8.

CHEST AT INSPIRATION.

Inches	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
29	2				2
30					
31	5	1	5	4	15
32	10	2	6	4	22
33	17	7	24	16	64
34	26	8	15	9	58
35	28	4	20	19	71
36	29	19	21	15	84
37	15	9	5	20	49
38	15	3	5	9	32
39	8	5	5	2	20
40	2	2	3	6	13
41	3	2	3	1	9
42					
43					
44			1		1
45		1		1	2
46		1			1
47		1			1
n	160	65	113	106	444
A	35.263	36.369	35.044	35.632	
σ	2.285	3.032	2.437	2.427	
V	.0647	.0834	.069	.068	
Em	.181	.376	.229	.236	

TABLE 9.

TRANSVERSE DIAMETER.

Cm.	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
23			5	1	6
24	4	1	5	3	13
25	20	5	15	8	48
26	21	12	21	16	70
27	24	14	21	16	75
28	29	10	15	18	72
29	23	11	12	16	62
30	17	4	4	13	38
31	11	3	7	9	30
32	5	3	2	4	14
33	1	1	1	1	4
34	1		2		3
35		1			1
36		1	1		2
n	156	66	111	105	438
A	27.865	28.045	27.288	28.009	
σ	2.088	2.345	2.462	2.10	
V	.075	.0836	.0902	.075	
Em	.167	.289	.234	.205	

TABLE 10.
MOBILITY.

Inches	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
.5				1	1
1.0	1		6	1	8
1.5	6	4	7	7	24
2.0	23	7	18	17	65
2.5	29	22	21	32	104
3.0	33	11	32	19	95
3.5	27	11	18	16	72
4.0	20	6	7	9	42
4.5	14	2	2	4	22
5.0	4	2	2		8
5.5	2		2		4
n	159	65	115	106	445
A	3.119	2.82	2.80	2.76	
σ	.912	.806	.903	.78	
V	.281	.284	.349	.207	
Em	.072	.099	.084	.086	

Pulse Rate. As required by the regulations of the Surgeon General's Office three counts of the pulse rate were taken: an initial count; a second after a dancing exercise of fixed period; and a third after two minutes of rest. In the tables we give the distributions for the pulse readings, rounded off by fives. So far as we know, no careful studies of the accuracy of pulse counting have been made. The usual method in clinical practice is to count for fifteen seconds and then multiply by four. This will result in rounding off as, 76, 80, 84, etc., without intervening values. Further, an error of one count will be recorded as an error of four counts. This undoubtedly introduces a large accidental statistical factor. However, in the data here used the method was to count for a full half minute, thus greatly increasing the accuracy. Yet, it appears that the observer tended to round off the record somewhat by reading to favorite numbers. So, from inspection, it seemed quite sufficient to tabulate the series in units of five beats.

One of the striking features in the records is the high readings for some initial counts. No doubt some allowance must be made for the mental stress of the examination and the serious nature of the whole situation. Influenza was raging at the time and some of the subjects were slightly ill, as will appear in the temperature tables. Yet, these conditions were the same for each group and so are not a disturbing factor in our comparisons. To this we shall revert under the head of Correlations.

Studies of the pulse rate in the Carnegie Nutrition Laboratory indicate great fluctuations even in a state of rest and relaxation, the variations in the same individual from day to day ranging in some cases from twenty to thirty beats. The rate is also greatly accelerated by vigorous exercise and is sensitive to changes in diet and ordinary mental work. All this introduces a variable complex into our records, but yet, other things being equal, should bear upon all our nationality groups equally.

The table shows the group rates, and taking the United States parentage group as the standard, we get the following:—

	Before	After	Rest
United States parentage	89.572	116.88	94.228
Mixed parentage	+1.428	—2.65	+0.160
Foreign parentage	+0.328	—2.74	—1.420
Foreign born	+0.112	—1.54	—2.740

All these differences are, it is true, within the range of accidental variation, but show a tendency for the foreign born factor to respond

less to exercise and to recover more rapidly, notwithstanding that the initial rate tends to increase with foreign birth.

Another way to express this relation is by taking the differences for each group, showing the acceleration of the rate.

	Increase by exertion	Increase after rest
United States parentage	+27.308	+4.656
Mixed parentage	+23.230	+3.388
Foreign parentage	+24.240	+2.908
Foreign born	+25.656	+1.804

Here again it appears that the foreign born are less accelerated by exercise and recover more rapidly. As in case of respiration this may mean a real resistance, or a mere mental attitude in that the foreign born entered less enthusiastically into the exercise. From personal observations during the examinations, the writer suspects the latter to be the true interpretation and that this applies equally to the respiration tests.

The age factor may operate here, as when we select out the older men, or all over twenty-seven years, we have the following:—

Pulse 2.	n	A	σ
Foreign born, over 27 years	68	116.7	21.5
Of United States parentage, over 27 years	77	118.2	20.2

It will be observed that in each case (Table 12) the rate for the older men is higher than for the younger. This is to be expected. Yet again, the rate for the foreign born is less. This, therefore, approaches a real difference.

The question of stature and weight should be considered, since there is a difference in size between the different nativity groups; but a careful treatment of data by Harris and Benedict[1] indicates a barely perceptible positive correlation in this respect. This would be negligible in our data. The same authors review the relation between age and pulse rate, showing that there is a slight decrease with age; but this need not be considered here since the averages for Pulse 1 are approximately the same.

[1]Harris, J. Arthur and Benedict, Francis G., "A Biometric Study of Basal Metabolism in Man" (*Publication 279, Carnegie Institution of Washington*, Washington, 1919).

TABLE 11.
PULSE 1.

Beats	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
60	1		1	1	3
65	4			3	7
70	7	6	12	18	43
75	7	4	5	8	24
80	22	4	15	7	48
85	24	10	13	5	52
90	27	5	15	12	59
95	18	9	14	14	55
100	13	3	12	8	36
105	4	1		3	8
110	6	3	6	7	22
115					
120	4	3	5	5	17
125					
130	1	2		3	6
135	1		2	1	4
140	1				1
n	140	50	100	95	385
A	89.572	91.0	89.9	89.684	
σ	13.454	15.33	14.177	17.176	
V	.150	.168	.158	.192	
Em	1.137	2.168	1.418	1.762	

TABLE 12.
PULSE 2.

Beats	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
65		1			1
70	3		1		4
75			1		1
80	1	2	1		4
85	6	2	2	5	15
90	3	2	6	6	17
95	5	3	7	4	19
100	13	5	11	9	38
105	4	4	7	5	20
110	18	4	6	11	39
115	11	1	5	6	23
120	21	10	25	18	74
125	8	4		2	14
130	11	7	8	10	36
135		1	2	1	4
140	6	3	2	3	14
145	7	2	5	2	16
150	4	1	1	2	8
155	1				1
160	2		3	1	6
165				1	1
170					
175					
180					
185				1	1
n	125[1]	52	93	87	357
A	116.88	114.231	114.14	115.345	
σ	20.952	18.762	18.762	19.026	
V	.179	.164	.164	.165	
Em	1.852	2.602	2.170	2.039	

[1]One case at 220 has been omitted from the table.

TABLE 13.
PULSE 3.

Beats	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
50	1				1
55					
60	2		2	1	5
65	2	1	1	1	5
70	2	1	4	12	19
75	5	1	2	3	11
80	13	4	10	8	35
85	19	8	9	8	44
90	17	10	19	18	64
95	20	9	14	6	49
100	10	6	11	11	38
105	4	1	4	1	10
110	11	4	6	6	27
115	2	1	1	2	6
120	7		3	3	13
125	1		1	1	3
130	2	2	2	1	7
135	1				1
140	2	1		1	4
145				1	1
150					
155					
160					
165					
170					
175					
180	1				1
n	122	49	89	84	344
A	94.221	94.388	92.808	91.488	
σ	15.588	14.213	14.036	16.553	
V	.1654	.151	.1512	.181	
Em	1.411	2.030	1.487	1.806	

A careful series of repeated observations were made in Budapest by Körösy in 1910 and reported upon by Bell.[1] In this case the subjects were soldiers and all records were taken in the morning before rising. The average of 255 cases was 64.2±8.48. The range was from 45 to 85 with two high readings. The form of distribution was slightly asymmetrical.

Turning now to our distribution, we may, for greater convenience, re-tabulate the data for the three successive pulse counts and smooth out the curves by using intervals of ten beats. The graphs for these

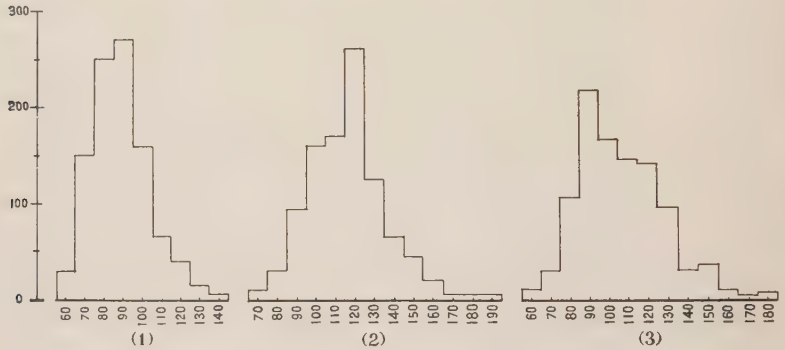

Fig. 1. Pulse Graphs, Table 14.

distributions are presented in Fig. 1. One first observes that the form of distribution for Pulse 1 is closely similar to the curve published by Julia Bell.[2] In fact the correspondence is so close that we may assume Miss Bell's curve to be a true picture of the pulse for a group of European males. We have in our data, however, an interesting presentation of what happens to the group when subjected to exercise. The immediate result of such exercise (Pulse 2) is to extend the base of the curve. Then, after a rest interval, the curve tends to return to its approximate initial form. Further, it seems that the curve for Pulse 2 tends to be the reverse of that for Pulse 1. In any case, the return after rest to the initial form is proof that we have here an approximate picture of the pulse for adult males.

Satisfactory data on the pulse rate for other than white subjects are not readily accessible. Hrdlicka maintains that the rates for certain American Indians are lower than for whites, the range being 44 to 78 for

[1]Bell, *ibid.*, 232–236.
[2]Bell, *ibid.*, 235.

TABLE 14.
PULSE COUNTS PER THOUSAND CASES.

Beats	Count 1	Count 2	Count 3
50	0	0	0
60	31	1	10
70	153	13	32
80	251	34	104
90	272	95	218
100	163	161	165
110	67	170	144
120	41	260	140
130	15	126	95
140	7	67	32
150		46	38
160		20	11
170		1	1
180		2	7
190		1	
200			
210			
220		3	3
Totals	1000	1000	1000

adult males.[1] As previously stated, the carefully studied white squads in nutrition experiments showed individual rates of 31 to 74 for adult males lying at rest and 50 to 89 when standing. The daily averages for the groups, standing, ranged from 61 to 76. Gould[2] in Civil War data gave the average for 503 Indians as 76.31. Hrdlicka[3] rejects this as an error on the ground that no pulse could be so high, but our data and the works just cited indicate that it can. Ferris[4] reports observations on Quichua Indian men: n, 74, average pulse 74.0±9.6, with a form of distribution approximating our series for drafted men. This is not far from the Civil War Indian average. It is, therefore, still a question as to whether Indians have a slower pulse. The obvious sensitiveness of the pulse rate to diet, position, activity, mental stimulation, etc., requires that laboratory methods be used for group and race comparisons.

Some observations have been made upon Filipinos by Chamberlain and others. Two hundred natives gave an average of 79.1, another series of 536 males an average of 81.5. The effect of tropical climates is in dispute, but the evidence seems to indicate an increase of about ten beats per minute for whites of several years' residence in the tropics.

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[1]Hrdlicka, *ibid.*, 141.
[2]*Investigations in the Military and Anthropological Statistics of American Soldiers* (1889).
[3]Hrdlicka, *ibid.*, 141.
[4]Ferris, *ibid.*, 52.

If this is correct, the Filipinos have a lower pulse rate than the Americans and Europeans examined by us, but the stress of the examination to which our subjects were subjected must be considered.

Blood Pressure. Blood pressure was taken in the customary manner and the readings recorded in fives. The ranges and frequencies for each group are given in the table. While it is true that the error in this measurement is known to be large, the forms of the distribution and the variabilities indicate considerable accuracy. The tables show that in some of the readings, the scale was read in tens, in others in fives. This will account for certain irregularities in the series. Yet in no case are the group differences large enough to be significant.

Researches in nutrition have brought to light some data upon the variability of blood pressure; for instance, it is found to vary with food shortage and slightly with exercise. Initial tests upon one experimental squad, normal conditions, indicated individual ranges of (S) 105 to 142; (D) 75 to 90. Considering that these were selected subjects, the range is comparable to that in our data. A test of one squad after twenty-four minutes of walking on the level, was made at intervals to nine minutes, individual variations of (S) 5 to 26; (D) 5 to 19. These ranges, it will be noted, are on the average, something less than the variabilities for our groups. Much greater ranges are reported by Faught.[1] Hence, notwithstanding the great number of observations made upon blood pressure readings in normal individuals, no one seems to have subjected these data to a rigid analysis by the methods used in biometric problems. It is, therefore, impossible to compare our series satisfactorily with the results obtained by others.[2]

The evidence that, on the average, blood pressure will rise with age is conclusive, but for reasons just stated no one can yet say what the approximate range of this correlation is. Woley's table, for example, shows a range of 120 to 135, between the ages of 15 and 60, an increase of 15 in forty-five years.[3] Oliver,[4] quotes life insurance data showing an

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[1]Faught, Francis Ashley, *Blood-Pressure from the Clinical Standpoint* (Philadelphia, 1916), 402–403.

[2]Since this was written there came to hand an important study by Alvarez, Wulzen, and Mahoney, (Alvarez, Walter C., Wulzen, Rosalind, and Mahoney, Lucille, J., "Blood Pressure in Fifteen Thousand University Freshmen" *Archives of Internal Medicine*, vol. 32, no. 1, July, 15, 1923) made on some fifteen thousand cases, taken in California. The average for men between the ages of sixteen and forty (6000 cases) is 128.9±13.5. For the age group the averages range from 126.7 to 130.1 and the standard deviation from 12.2 to 14.1 It will be noted that these readings are slightly lower and a little less variable than our readings on drafted men. However, these investigators found that the blood pressure for both men and women was markedly lower in 1918 than in the following years, the low pressure being coincident with the influenza outbreak. Our readings, on the other hand, are approximately equivalent to those in California for 1919–20. If the same conditions prevailed among the population of New York City in 1918, our readings should be considered lower than what would have been found in 1920, otherwise the averages could be considered equivalent.

[3]Norris, George William, *Blood-Pressure, its Clinical Applications* (Philadelphia, 1917), 56.

[4]Oliver, George. *Studies in Blood-Pressure, Physiological and Clinical* (New York, 1916), 110.

increase of 16 in forty-five years. Faught[1] states that for each two years of life 1 should be added, but he does not give the basis for this conclusion. This would indicate that the increase for a year of age will range from one third to one half a unit for systolic readings.

Since our subjects vary considerably in age and, as will be seen in Table 3 fall into two age groups, it seemed desirable to regroup them. Those called in the second draft ranged from twenty-eight to forty-five years and, when taken alone, give the following results:—

28–45 yrs.	*n*	*A*	σ
Foreign born	68	131.2	17.2
United States parentage	84	131.3	13.9

It is thus apparent that when the age factor is equalized, the blood pressure for the different groups remains the same.

No comparative racial data have come to our notice.

Certain researches in tropical medicine in the Philippine Islands should be noted in this connection.[2] From the results so far published it appears that Filipinos have a lower pressure than Americans living at home, but not appreciably different from Americans residing in the Islands. For example:—

Filipinos (Chamberlain), 21–25 years	115.4
" (Concepcion and Bulatao), 21–30 years	113.5
Americans, P. I. (Musgrave and Sison), 25–40 years	113.0
" , U. S. (Woley), 21–30 years	122.0

Other data (diastolic and pulse pressure) compiled by these investigators are consistent with the foregoing, so that the blood pressure of the Filipinos appears to be the same as that for Europeans when subjected to the same environment. It is thus apparent that all racial comparisons in blood pressure must take into account the climatic variable. One point, however, seems established; viz., that Filipinos and Europeans give the same average under like conditions.

We may also note that the average for Hindus residing in Calcutta is given as 100 Hg., arterial pressure,[3] which is lower than for Europeans at home. In this again allowance must be made for climate. Recently there appeared some data on the blood pressures for Cantonese, 18–25 years, ranging from 100 to 108, D pressure from 68 to 78. As compared

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[1]Faught, *ibid.*, 401.

[2]Concepcion, Isabelo, and Bulatao, Emilio, "Blood-Pressure Picture of the Filipinos (*The Philippine Journal of Science*, vol. 11, section B, 135–149, Manila, 1916); Musgrave, W. E. and Sison, A. G., "Blood Pressure in the Tropics. A Preliminary Report" (*The Philippine Journal of Science*, Vol. 5, section B, 325–329, Manila, 1910); Chamberlain, Weston P., "A Study of the Systolic Blood-Pressure and the Pulse Rate of Healthy Adult Males in the Philippines" (*The Philippine Journal of Science*, vol. 6, section B, pp. 467–482, Manila, 1911).

[3]Oliver, *ibid.*, 115.

with other data these readings are low, but perhaps here also allowance must be made for local conditions.[1]

As to the American Indian the statement is made that no certain variations have been noted from the readings for whites up to the forty-fifth year of life, but that after that time Indians give lower readings than whites. However, no data are given by this author.[2]

In general, then, the suggestion is that the blood pressure for human kind is a constant, but more data are needed to prove the point.

TABLE 15.

BLOOD PRESSURE (S).

Pressure	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
95		1			1
100			1		1
105		1	1	1	3
110	10	5	4	9	28
115	2	2	3	3	10
120	38	10	17	20	85
125	11	5	6	9	31
130	27	12	22	25	86
135	8	3	8	4	23
140	20	3	17	16	56
145	3	2	3		8
150	9	3	3	2	17
155	1			3	4
160	3	4	6	2	15
165					
170	2	1		1	4
175				2	2
180		1	2	1	4
185			1		1
190			1		1
n	134	53	95	98	380
A	129.963	130.566	133.473	130.408	
σ	12.689	16.912	16.462	14.799	
V	.0976	.129	.1233	.1134	
Em	1.096	2.323	1.688	1.494	

[1]Cadbury, W. M. "Blood Pressure of Normal Cantonese Students" (*China Medical Journal*, ol. 37, pp. 715–725, Shanghai, September, 1923).
[2]Faught, *ibid.*, 163.

TABLE 16.

BLOOD PRESSURE (D).

Pressure	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
40		1			1
45			1		1
50					
55					
60	7	5	4	2	18
65	6	1	3	1	11
70	17	9	20	16	62
75	12	4	6	4	26
80	40	13	27	26	106
85	11	3	6	3	23
90	23	12	15	24	74
95	6	1	2	4	13
100	11	3	5	7	26
105			1	2	3
110			3		3
115			2		2
n	133	52	95	89	369
A	81.015	78.942	81.105	83.033	
σ	10.344	12.0	12.728	10.247	
V	.128	.152	.157	.123	
Em	.897	1.664	1.305	1.086	

Temperature.

The readings for rectal temperature were taken with a clinical thermometer in the usual manner, and, like the other observations reported here, made by a specialist in medicine. The total distributions are shown in the table.

Table 17

Rectal Temperature Readings.

Degrees	Born in United States			Foreign Born	Total
	U. S. Parents	Mixed Parents	Foreign Parents		
98.0	3	0	0	0	3
98.2	2	1	4	1	8
98.4	3	0	0	3	6
98.6	1	2	1	2	6
98.8	17	9	4	18	48
99.0	37	20	23	28	108
99.2	24	9	9	10	52
99.4	15	10	9	9	43
99.6	12	6	3	3	24
99.8	7	3	2	3	15
100.0	21	6	9	11	47
100.2	4	1	3	1	9
100.4	5	0	1	1	7
100.6	1	1	2	0	4
100.8	1	0	1	0	2
101.0	1	1	2	1	5
101.2	1	0	1	1	3
n	155	69	74	92	390
A	99.3	99.3	99.4	99.2	
σ	0.57	0.48	0.65	0.53	
V	0.006	0.005	0.006	0.005	
Em	0.046	0.058	0.076	0.055	

Inspection of the distributions indicates, first, that the nodes for each group are the same, 99.0. The constancy of this is a certain indication of its validity for these groups. Next we observe that the form of distribution is asymmetrical and equally so for each subgroup. And in keeping with this, there is a secondary node at 100.0, again constant for all the subgroups.

These consistencies are strong evidence that we have in the table a true sample of New York City males at the period of examination. One notes that the high readings are quite evenly distributed among the subgroups, so all were subject to the same conditions. The coincidences of the nodes and ranges at once banish the possibility of racial differences in these groups, but to meet the conventional requirements of such research we have calculated the averages as shown. The maximum difference is less than three times the error of the average, too low to be significant.

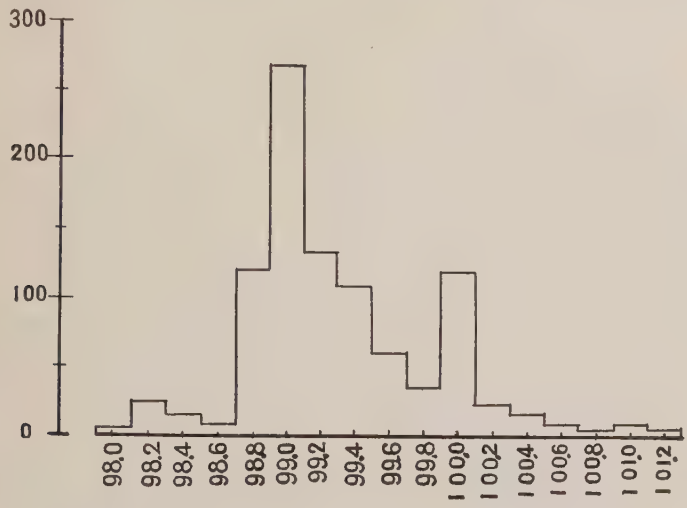

Fig. 2. Temperature Graph on Basis of a Thousand Cases.

Returning now to the consideration of the distributions, it may be objected that the node at 100.0 is due to the well-known habit of rounding off in reading the scale in the thermometer. Thus Fig. 2 shows the relation of these nodes to the total curve. It is reasonably certain that they are exaggerated by rounding-off, but still the form of the curve is such that the actual nodes would be expected at the same points. So, taking into account the fact that these readings were taken with great care, we regard the evidence as favoring the existence of two nodes.

The import of this would be that we are dealing with two separate series, one for normal temperature and one for a type of illness.

Inspection of the plotted curve (Fig. 2) indicates a sharp rise at each node. The two parts of the curve are so strikingly alike, that one is led to assume that the nodes represent two quite different levels of bodily

temperature. In other words, we suspect that there are two distributions in one.

The first of these may be designated as the normal series, the node to which is 99.0, and the individual range from 98.0 to 99.8.

The average rectal temperature is given as 98.96, which is approximately the first node in our series. Unfortunately, we have not found in the literature of the subject a comparable series of rectal readings for a group of men selected at random, but note should be taken of a few contributions. For example, a careful study of bodily temperature by Benedict and Slack[1] demonstrates that the rectal reading is the most constant and the best index to the temperatures for other parts of the body. Yet, the rectal reading will vary with the depth of insertion up to 6 cm. In addition, there is a perceptible variation in bodily temperature with the taking of food, position of body, exercise, etc. Age and size may be a factor also, but as reviewed by Hrdlicka[2] these differences are barely perceptible in children and tend to vanish in the adult. Yet, as his conclusions are based upon sub-lingual tests, less constant than rectal tests, they are not strictly comparable to our data.

In general, then, what literature we have consulted suggests that our first node and its part of the curve is an approximate picture of the rectal temperature in a normal group of males going about their daily work and regarding themselves as in good health. Further, all of our examinations were made between eight and eleven p.m.

At this point it may be well to note that the period during which these readings were taken coincided with the influenza outbreak of 1918. One may then suspect that the second node defines a curve which is a picture of a group with influenza. The average reading for this group would be approximately 100.14+. Yet other factors must be considered. As a try out we segregated all cases with a temperature of 100+ and found them as follows:—

	Foreign Born	Foreign Parents	Mixed Parents	U. S. Parents	Totals
Heart and lungs normal	10	14	7	16	47
Bronchitis and influenza	3	2	0	3	8
Heart defects	7	3	3	9	22
Lung defects	0	1	0	1	2
Tuberculosis	0	1	0	0	1
					80

[1] *Ibid.*
[2] *Ibid.*, 142.

Thus for more than half of these high temperature readings no cause can be assumed from the record; of the remainder, exactly two-thirds are associated with heart defects and irregularities, most of them very slight and usually merely rapid action. If then we should throw out these 33 cases having other defects of heart and lungs, the form of the series would not be greatly modified because we found no correlations between these defects and degree of temperature. The suggestion is, however, that slight increases in temperature tend to accompany heart defects, but the number of cases we have is too small to give definite results. As the table shows, influenza was observed in but few cases, yet for all that, it may have been the cause of half the total cases with high temperatures.

However, the interpretation of this series goes beyond our problem. The suggestion is, however, that the correct way to arrive at a true picture of a state of influenza would be to make extensive examinations in schools or industrial organizations when the disease is at its peak.

Our next problem is to determine the approximate average of our normal series. If we take out the abnormal series, the average will be slightly lowered, approximately 99.06. Thus, the first node is the approximate average for the first series. It is well to note, however, that the foregoing corrected average is 0.10 higher than the assumed standard of 98.96.

Finally, as to subgroups, or racial differences, it is clear that nothing of the kind can be established for these data, neither in the normal series, nor in the abnormal group.

Racial comparisons have been made by Hrdlicka upon Indians and whites. His tables show the same ranges as for our readings, but he claims a slightly lower temperature for Indians. Yet his differences range from 0.7 to 0.2, and the maximum difference for our group is 0.7. As we have noted, this is not quite twice the probable error of the average; hence, it is doubtful if Hrdlicka is justified in assuming a real difference for whites and Indians.

Summary. While the number of observations are too small to be given positive value, their consistency points to the probable outcome of further investigations along this line. It is not only suggested that the fundamental functions and processes herein recorded are equal for all European stocks, but for all human kind under similar environments and procedure. Yet, this should be taken as tentative until more data are available.

As samples of adult males selected at random from our population these results must be considered. Rarely do we find in medical literature comparable data. The tendency for the types of distribution, here shown to be constant, indicates a new approach to an understanding of the normal group. To date, no one seems to know just what to expect as to temperature, pulse, blood pressure, etc., in the population at large. Yet, this problem is approachable, as we have shown.

Correlations.

So far we have treated our measurements separately without considering their possible relations. For example, it is believed that a high temperature is accompanied by a rapid pulse, but no one knows to what degree these coincide. Since both temperature and pulse are highly variable, we may expect that their correlations in individuals will vary also. In biometrics, techniques have been devised for calculating the average correlations for such functions in individuals taken at random. Thus, for any given pair of functions, observations, or dimensions, a coefficient (r) of relation can be calculated ranging from 0 to 1. The reliability of these coefficients increases with the number of cases, the number we have being too low for final conclusions. Yet, since we have been able to find but a single attempt to correlate medical observations of this kind, it has seemed worth while to make approximate calculations for the preceding data.

Pulse Rate. One may, for example, ask, What are the chances that a low initial pulse will also be low after exercise? Or, to what degree will the individuals examined hold their ranks in the group? This can be determined by correlation, the complete data for which is given in the table (p. 299). In this case we find the coefficient of correlation to be +0.78, a high degree of relation for variable phenomena. In other words, the person with a low initial pulse was also relatively lower after exercise. Hence, on the average, the acceleration caused by exercise is constant for all.

To check this finding, we calculated all of the possible correlations for the three pulse counts:—

	All males 18 to 27 years	
	Cases	r
Pulse 1 and 2	163	+0.73
Pulse 1 and 3	164	+0.78
Pulse 2 and 3	163	+0.86

TABLE 18.

CORRELATION OF INITIAL PULSE RATE WITH PULSE RATE TWO MINUTES AFTER EXERCISE.

Two minutes after exercise	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	Totals
Initial pulse																				
60	1																			1
65			1	2			1													4
70			1	1	5	4	4	1						1						17
75					2	2	1	1	3	1										10
80						2	8	3	9	2										24
85				1	1		3	6	5	5	1	1	1							24
90							2	3	12	2	3		2							24
95							2		2	8	6		1		1					20
100					1			1	4	4	3	2	2	1	1					19
105									2			2				1				5
110									1			1			1		1			4
115																1				1
120												2			4		2			8
125											1									1
130																	1		1	2
Totals	1		2	4	9	8	21	15	38	22	14	8	6	2	7	2	4		1	164

$r = +0.78 \pm 0.015$

The differences between these coefficients are so small that they may be considered accidental. As the result stands, then it means that exercise tends to accelerate all men equally, regardless of their initial pulse rate or that the individual holds closely to his rank throughout; the slow are always slow, the fast always ahead.

The above calculations serve another function. They are proof that the counts were made with accuracy.

The only comparable attempt to correlate data of this kind, so far noted, is found in a study of pulse and respiration rates by Julia Bell.[1] Her results were:—

Adult males, 20–24	n	r
Pulse rate and stature	253	-0.072 ± 0.042
Respiration rate and stature	253	-0.042 ± 0.042
Pulse rate and respiration rate	255	$+0.108 \pm 0.042$

As these subjects were at rest, we can compare our coefficient for respiration rate and Pulse 1, which is $+0.45$. This is much higher. However, if we correlate normal breathing rate with Pulse 3, the coefficient is but $+0.25$; doubtless had we the breathing rate at the time Pulse 3 was taken, the correlation would have been higher. In any case, the excess of our coefficient over that obtained by Miss Bell, is probably due to the fact that her subjects were examined before rising in the morning.

Blood Pressure. The pulse readings are the only observations that were repeated on the individual, but in blood pressure we have two readings, systolic and diastolic. When we correlate S and D in the same manner as the preceding, we find for the age group 18–27, $n = 177$, $r = +0.15$. This is equivalent to a low correlation and means that rank in S is some indication of where one will stand in D. In other words, this means that there is great variability in these respects, so that one cannot definitely predict as to diastolic pressure when systolic pressure is known, and the reverse.

We have also calculated the following correlations for blood pressure:—

	n	r
Blood Pressure (D) and Pulse 3	155	$+0.06$
Blood Pressure (S) and Respiration Rate	171	-0.03

This is equivalent to no correlation.

Vital Capacity and Mobility. When one blows into the spirometer, it may be expected that the volume of air discharged will bear some direct relation to the mobility of the chest. So we have calculated the

[1] Bell, *ibid.*, 232–236.

correlation for the spirometer readings and the mobility of chest, as measured:—

Ages	n	r
18–27	149	+0.47

Thus there can be no doubt that a direct relation exists here.

Other correlations for mobility were obtained, as:—

Ages 18–27	n	r
Mobility and Pulse 3	159	+0.12
Mobility and Respiration Rate	170	—0.34
All ages		
Mobility and Respiration Rate	388	—0.46

Thus there appears a slight tendency for pulse rate and mobility to correlate, whatever this may mean. On the other hand, we note a negative coefficient for respiration rate. This means that if the mobility is great, one breathes slowly; if mobility is low, one can breathe faster.

Temperature. As we have shown, there are good reasons for regarding the temperature series as compound, which would disturb the correlations with temperature somewhat. As no important age differences were noted in either temperature or Pulse 1 we have correlated the entire group, as:—

Ages 18–45	n	r
Temperature and Pulse 1	385	+0.20

This indicates a small amount of correlation and is so far in keeping with the medical tradition that a high temperature is sometimes accompanied by a fast pulse. Of course, we are dealing with what are for the most part normal cases.

We have also calculated the correlations for blood pressure, but here the coefficient is much lower, though with a tendency to be positive, as:—

Ages 18–27	n	r
Blood Pressure (S) and Temperature	171	+0.06
Ages 28–45		
Blood Pressure (S) and Temperature	171	+0.05

We also calculated the correlation for temperature and respiration rate:—

Ages 18–27 $n = 171$ $r = +0.06$

Thus, there is no marked correlation for temperature except with pulse rate. That this is not an accidental finding we have ascertained by dividing the series into two age groups:—

Ages 18–27	$r = +0.22$
Ages 28–45	$r = +0.21$

Table 19.

Table of Correlations.

18–27 years	n	r
Pulse 1 and 2	163	+0.73±0.026
Pulse 1 and 3	164	+0.78±0.015
Pulse 2 and 3	163	+0.86±0.013
Pulse 3 and Mobility	159	+0.12±0.051
Pulse 3 and Blood Pressure (D)	155	+0.06±0.055
Pulse 1 and Respiration Rate	171	+0.45±0.040
Pulse 3 and Respiration Rate	155	+0.25±0.050
Pulse 1 and Temperature	170	+0.22±0.048
Mobility and Vital Capacity	149	+0.47±0.041
Mobility and Respiration Rate	170	−0.34±0.045
Respiration Rate and Temperature	171	+0.05±0.051
Respiration Rate and Blood Pressure (S)	171	−0.03±0.051
Blood Pressure (S) and Pressure (D)	177	+0.15±0.049
Blood Pressure (S) and Temperature	171	+0.06±0.051
18–45 years		
Pulse 1 and Temperature	385	+0.20±0.029
Mobility and Respiration Rate	388	−0.46±0.014

Miscellaneous Medical Data. Medical investigators are now taking a deep interest in the possibility of discovering correlations between functional conditions and anatomical characters. The possibility of such discoveries was recognized in these examinations and data were gathered to test out some of the assumed correlations. For various reasons it has been assumed that correlations may be expected between the following:—

1. Hair form, hair texture, and stature
2. Hair form and skin moisture
3. Hair texture and freckles
4. Development of hair, blood pressure and stature
5. Blood pressure with eyebrow development, form of nose bridge, nose profile, etc.
6. Respiration rate with nose bridge, nose profile, skin texture, etc.
7. Eye color with skin texture
8. Loss of teeth with development of hair, skin color, hair texture, hair form, blood pressure.

At least, these are some of the hypothetical correlations that could be made with the data collected, not to mention the possibility of checking over those well established, such as size and hernia, foot arch and hernia, etc.

We have tried out a few of the foregoing, as may be seen in the accompanying tables. Nothing could be told about hair form and skin moisture because few subjects were rated as moist. The correlation for hair form and hair texture was also generally negative. It is true that the few cases of frizzly hair noted are also coarse, but otherwise the differences are not definite. Reference to the table of ancestry will show that there was no appreciable amount of acknowledged negroid blood in these groups.

Freckles show no relation to skin texture as recorded (Table 20). We have tried out blood pressure with development of eyebrows, nose bridge, and profile as shown in Tables 23 and 24. It seemed unnecessary to calculate the averages for every column in these tables for reasons that are obvious. The difference in Table 24 is no greater than should be allowed for accidental causes. If, however, the 17 cases for low nose bridge are in any way representative of their group, there is a real difference in that a low nose bridge goes with a low blood pressure. Yet the probabilities are against such an outcome.

In Table 25 the observations are more evenly distributed, but again are not large enough to be taken with confidence.

Table 20.

Correlation of Skin Texture and Freckles.

	Freckles Present		Freckles Absent		Totals	
	n	%	*n*	%	*n*	%
Coarse	6	7	28	7	34	7
Medium	62	74	290	76	352	76
Fine	16	19	64	17	80	17
Totals	84	100	382	100	466	100

TABLE 21.

CORRELATION OF BLOOD PRESSURE WITH OUTER THIRD OF EYEBROWS.

Blood Pressure	Outer Third of Eyebrows		Totals
	Present	Absent	
95	1		1
100	2		2
105	2	2	4
110	22	6	28
115	11		11
120	77	9	86
125	20		29
130	104	8	112
135	20	2	22
140	51	3	54
145	10	1	11
150	13	5	18
155	4		4
160	11	2	13
165	1		1
170	5		5
175	2		2
180	4		4
185	1		1
190	1		1
n	362	47	409

Correlation of Blood Pressure with Development of Nose Bridge.

Blood Pressure	Nose Bridge			Totals
	High	Low	Medium	
95			1	1
100	2			2
105	3	1		4
110	10	5	14	29
115	6	2	4	12
120	33	5	46	84
125	13		14	27
130	43		51	94
135	12		10	22
140	32	2	24	58
145	4		7	11
150	10		8	18
155	1		3	4
160	6	1	6	13
165			1	1
170	3		2	5
175	1		1	2
180	1	1	1	3
185	1			1
190	1			1
n	182	17	193	392
A	133.34		135.59	
σ	15.45		13.70	
V	.116		0.101	
Em	1.14		0.986	

TABLE 23.

CORRELATION OF BLOOD PRESSURE WITH NOSE PROFILE.

Blood Pressure	Nose Profile			Totals
	Straight	Convex	Concave	
95	1			1
100			2	2
105	2	1	1	4
110	14	11	10	35
115	6	4	5	15
120	37	29	20	86
125	10	8	13	31
130	41	25	26	92
135	11	7	5	23
140	29	14	14	57
145	3	3	4	10
150	9	4	5	18
155	3	2		5
160	7	4	2	13
165			1	1
170	2	2		4
175	1	1		2
180	3		1	4
185		1		1
190		1		1
n	179	117	109	405
A	131.42	131.64	128.45	
σ	15.15	15.75	13.425	
V	0.115	0.119	0.105	
Em	1.13	1.46	1.29	

Nevertheless these negative results need not be taken as final, for the work was not carried on long enough to develop all the necessary special techniques involved. It is true here, as elsewhere, that a certain amount of actual experience with a phenomenon is necessary to the standardization of procedure. Future investigations in this line, must therefore be preceded by the working out of special techniques for recording the qualitative determinations for which correlations are sought.

Summary. A résumé of the calculated coefficients of correlation shows all of them positive in sign, save two. This means that there is some correlation between the processes involved. The number of cases we have is not large enough to establish correlation norms, but these results do make clear the need of such norms. No doubt many institutions in the country possess data that would lend themselves to such treatment, if such research were encouraged.

Some of the suggestions that our data offer are:—

1. Increased mobility of the chest to lower the respiration rate.
2. A rapid normal pulse tends to be coupled with a rapid breathing rate.
3. Normal blood pressure does not correlate appreciably with our other data.
4. Temperature tends to correlate with pulse rate but not appreciably with other data.

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